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Attached are the following pages:

- Brief for Appellant [16 pages];
- Claims Appendix [9 pages];
- Evidence Appendix [1 page]; and
- Related Proceedings Appendix [1 page].

Applicant: Paul Marie AYOUB

Group Art Unit: 1764

Serial No.: 10/772,023

Examiner: John C. Douglas

Filing Date: 02/04/2004

Atty. Docket No.: TH2229 (US)

Title: Methods of Preparing Branched Alkyl Aromatic Hydrocarbons

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**BOARD OF PATENT APPEALS AND INTERFERENCES
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:
Paul Marie Ayoub

Serial No.: 10/772,023

Filed: February 4, 2004

**For: Methods of Preparing
Branched Alkyl Aromatic
Hydrocarbons**

§
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Group Art Unit: 1764

Examiner: John Christopher Douglas

Atty. Docket: SHELL-TH2229

BRIEF FOR APPELLANT

**Commissioner for Patents
PO BOX 1450
Alexandria, VA 22313-1450**

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REAL PARTY IN INTEREST

The real party in interest in this appeal is Shell Oil Company.

RELATED APPEALS AND INTERFERENCES

Appellant, its legal representative, and its assignee are unaware of any other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

STATUS OF CLAIMS

Claims 1-43 were finally rejected in the final action mailed October 12, 2006. A notice of appeal and request for extension of time to file same was filed on January 12, 2007.

STATUS OF AMENDMENTS

All amendments have been entered. A copy of appealed claims 1-43 appears in the Claims Appendix.

SUMMARY OF THE CLAIMED SUBJECT MATTER

The present application provides a method for producing alkylated aromatics that produce surfactants having excellent biodegradability and detergency at reduced production costs. The method comprises isomerizing a first hydrocarbon stream comprising olefins and paraffins, alkylating aromatics with a "second hydrocarbon stream" produced from the isomerization, and dehydrogenating **paraffins in the alkyl aromatic hydrocarbons stream after alkylation and before isomerization**. See claim 1.

Isomerization

The isomerization comprises "introducing a first hydrocarbon stream comprising olefins and paraffins into an isomerization unit . . . to isomerize at least a portion of linear olefins in the first hydrocarbon stream to branched olefins." Claim 1 specifies that the second hydrocarbon stream comprises "at least a portion of the produced branched olefins." Claim 1.

-Alkylation

During alkylation, "[a]romatic hydrocarbons" are alkylated by "at least a portion of the second hydrocarbon stream," which comprises the branched olefins, to produce the alkyl aromatic hydrocarbons. Claim 1.

-Dehydrogenation

The product "alkyl aromatic hydrocarbons" are separated from an "alkylation reaction stream," leaving "an unreacted hydrocarbons stream and an alkyl aromatic hydrocarbons stream." At least "a portion of the paraffins and at least a portion of the olefins from the unreacted hydrocarbon stream" are separated, producing "a paraffins and unreacted olefins stream." "[A]t least a portion of the paraffins in the paraffins and unreacted olefins stream" are dehydrogenated to produce an "olefinic hydrocarbon stream." At least a portion of the "olefinic hydrocarbon stream" is introduced "into the isomerization unit."

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-43 are obvious under 35 U.S.C. § 103(a) over U.S. Patent No. 6,187,981 to Marinangeli ("M1") in view of U.S. Patent No. 6,111,158 ("M2")?
2. Whether claims 26-37 are obvious under 35 U.S.C. § 103(a) over M1 in view of M2 and further in view of U.S. Patent No. 5,523,503 to Funk, et al. ("Funk")?

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ARGUMENT**I. Background**

The present application provides a method for producing alkylated aromatics with branching effective to produce surfactants with excellent biodegradability and detergency at reduced production costs. After alkylation, "at least a portion of the paraffins in the paraffins and unreacted olefins stream" are dehydrogenated to produce an "olefinic hydrocarbon stream."

Claim 1. At least a portion of the "olefinic hydrocarbon stream" is introduced "into the isomerization unit." Claim 1.

II. WHETHER CLAIMS 1-43 ARE OBVIOUS UNDER 35 U.S.C. § 103(a) OVER U.S. PATENT NO. 6,187,981 TO MARINANGELI ("M1") IN VIEW OF U.S. PATENT NO. 6,111,158 TO MARINANGELI ("M2")**1. The rejection**

The examiner rejected claims 1-43 as obvious under 35 U.S.C. § 103(a) over Marinangeli ("M1") in view of U.S. Patent No. 6,111,158 to Marinangeli ("M2"). The examiner contends that

Marinangeli 1 discloses feeding paraffins into an isomerization unit; sending a portion of the isomerization product containing lightly branched paraffins to a dehydrogenation zone; sending a portion of the dehydrogenation product containing paraffins, [linear] olefins, branched olefins, and aromatics; sending the stream to an alkylation zone; and recycling the unreacted paraffins to the dehydrogenation zone. (see Marinangeli 1, column 29, line 34 - column 31, line 31 and column 25, lines 23-38).

Office action, p. 3. The examiner admits that "Marinangeli 1 does not disclose feeding olefins in the isomerization unit to produce branched olefins from linear olefins." Office action, p. 4.

However, the examiner contends that "Marinangeli 2 discloses feeding linear olefins to an isomerization step to produce branched olefins" (see Marinangeli 2, column 9, ll. 29-31 and 64-66). *Id.* The examiner also contends that "Marinangeli 2 discloses that the isomerization step converts linear olefins to branched olefins and that branched olefins react with aryl compounds to form alkyl compounds (see Marinangeli 2, column 10, ll. 19-25)." *Id.* The examiner concludes that

it would have been obvious to one having ordinary skill in the art at the time of the invention to modify the process of Marinangeli 1 to include feeding linear olefins to an isomerization step to produce branched olefins and feeding the isomerization product to

an alkylation zone to produce phenyl-alkanes for detergent range alkylbenzenes including linear, branched, and modified alkylbenzenes and producing unreacted benzenes in order to convert olefins to alkyl compounds.

Id. The examiner contends that "it would have been obvious to separate the unreacted aromatics and the unreacted paraffins and olefins from the alkyl aromatic product in order to obtain a pure product" and to perform the other process steps. Office action, page 5.

According to the examiner, the "motivation is that the isomerization step of M1 can be used to convert linear olefins of M2." Office action, p. 9. The examiner contends that "it would be obvious to integrate the processes of M1 and M2 in a single process according to MPEP 2144.04 V.B. The examiner does not cite a reference to support this contention. Instead, the examiner relies on *In re Larson*, 144 U.S.P.Q. 347, 349 (C.C.P.A. 1965) ("the use of a one piece construction instead of the structure disclosed in [the prior art] would be merely a matter of obvious engineering choice").

The examiner contends that "it would have been obvious to place the dehydrogenation step after the alkylation step instead of between the isomerization step and the alkylation step." *Id.* (emphasis added). The examiner does not cite a reference to support the foregoing conclusion. Instead, the examiner cites *In re Burhans* for the general proposition that "the selection of any order of process steps is *prima facie* obvious in the absence of new or unexpected results," *In re Burhans*, 69 U.S.P.Q. 330 (C.C.P.A. 1946).

Apparently, the examiner contends that the facts in *Larson* and *Burhans* are sufficiently similar to those the present case for the examiner to rely on the rationale used by the C.C.P.A. MPEP 2144.04 V. B and IV. C.

2. Rebuttal

In order to establish that the claims are *prima facie* obvious over M1 in view of M2, the examiner must point to two things in the cited references, and not in the Appellant's disclosure-- (1) the suggestion of the invention, and (2) the expectation of its success. *In re Vaeck*, 20 U.S.P.Q.2d 1438, 1442 (Fed. Cir. 1991). The examiner has not met this burden.

The examiner has not pointed to a teaching or suggestion in the cited references of an aromatic alkylation process wherein an "alkylation reaction stream" is separated to produce a "paraffins and unreacted olefins stream," the method comprising:

introducing at least a portion of the paraffins and unreacted olefins stream into a dehydrogenation unit, wherein the dehydrogenation unit is configured to **dehydrogenate at least a portion of paraffins in the paraffins and unreacted olefins stream** to produce olefins, and wherein at least a portion of the produced olefins exit the dehydrogenation unit to **form an olefinic hydrocarbon stream; and**

introducing at least a portion of the olefinic hydrocarbon stream into the isomerization unit.

Claim 1 (emphasis added).

M1 is directed to "a process for producing aryl-alkanes by paraffin isomerization followed by paraffin dehydrogenation and then by alkylation of an aryl compound by a light branched olefin." M1, Abstract. In M1, **paraffins from the alkylation are isomerized and subsequently dehydrogenated.** The examiner argues that M2 "discloses feeding linear olefins to an isomerization step to produce branched olefins (see Marinangeli 2, column 9, ll. 29-31 and 64-66)" and that M2 "discloses that the isomerization step converts linear olefins to branched olefins and that branched olefins react with aryl compounds to form alkyl compounds (see Marinangeli 2, column 10, ll. 19-25)." Office action, page 3-4. The examiner concludes that

it would have been obvious to one having ordinary skill in the art at the time of the invention to modify the process of Marinangeli 1 to include feeding linear olefins to an isomerization step to produce branched olefins and feeding the isomerization product to an alkylation zone to produce phenyl-alkanes for detergent range alkylbenzenes including linear, branched, and modified alkylbenzenes and producing unreacted benzenes in order to convert olefins to alkyl compounds.

Id. According to the examiner, the "motivation is that the isomerization step of M1 can be used to convert linear olefins of M2." Office action, p. 9.

The examiner argues that "it would have been obvious to place the dehydrogenation step after the alkylation step instead of between the isomerization step and the alkylation step." Office action, p. 5 (emphasis added). The examiner cites no reference to support this conclusion.

The examiner cannot establish a case of *prima facie* obviousness of claims 1-43 merely by arguing that M1 could be modified to dehydrogenate paraffins *after alkylation and before isomerization*. In order to establish a case of *prima facie* obviousness, the examiner has the burden to point to a teaching or suggestion in the references themselves that it would be desirable to make the modification(s) required to produce the claimed method or composition.

In re Brouwer, 37 U.S.P.Q.2d 1663, 1666 (Fed. Cir. 1995). In order to establish a case of *prima facie* obviousness, “particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed.” *In re Kotzab*, 55 U.S.P.Q.2d 1313, 1317-1318 (Fed. Cir. 2000). The examiner has not provided a “finding as to the specific understanding or principle within the knowledge of a skilled artisan that would have motivated one with no knowledge of [Appellant’s] invention to make the combination in the manner claimed.” *Id.* at 1318. As a result, the examiner is engaging in impermissible hindsight reconstruction of the reference(s) using the claims as a template instead of using what is actually taught in the reference(s), themselves. *Id.*; *In re Fritsch*, 23 U.S.P.Q.2d 1780 (Fed. Cir. 1992), citing *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

The examiner certainly has not pointed to any teaching or suggestion of the cost savings and efficiency that could be achieved by making the claimed modifications. In M1, “[t]he dehydrogenated product stream removed from the bottom of the separation vessel 80 contains normal paraffins, lightly branched paraffins, normal monoolefins, lightly branched monoolefins, C₉-minus hydrocarbons, diolefins, aromatic by-products, and some dissolved hydrogen.” M1, col. 30, ll. 45-49. The dehydrogenation product is passed to a “selective hydrogenation reactor 86” which converts diolefins to monoolefins; to a “stripping column 90” in which “C₉-minus hydrocarbons” are removed from the C₁₀-plus hydrocarbons; and, to an “aromatics removal zone 100” in which aromatic by-products are removed.” M1, col. 30, ll. 49-col. 31, l. 23; see also M1, Fig. Thereafter,

[t]he effluent from the aromatics removal zone 100 is transferred via a line 98. This stream comprises an admixture of the normal paraffins, lightly branched paraffins, normal monoolefins, and lightly branched monoolefins, and has a greatly reduced concentration of aromatic by-products compared to the stripping effluent stream. This admixture is combined with benzene from a line 112 and passed via a line 102 into an alkylation reactor 104. In the alkylation reactor, benzene and the monoolefins are contacted with an alkylation catalyst at alkylation-promoting conditions to produce arylalkanes.

M1, col. 31, ll. 13-23 (emphasis added).

The pending claims do not exclude further processing the isomerization product before it is fed to alkylation. However, it is *not necessary* to further process an isomerization product

that is dehydrogenated *after* alkylation but *before* isomerization before it is fed to alkylation.¹

The examiner cites *In re Larson* for the proposition that it would have been obvious to integrate the paraffin process of M1 with the olefin process of M2. *In re Larson*, 144 U.S.P.Q. 347, 349 (C.C.P.A. 1965). Even if *Larson* were analogous, which applicant denies, the examiner still would not have established that modifying M1 with the teachings of M2 would produce an alkylation process in which **paraffins are dehydrogenated after alkylation and before isomerization**.

In any event, the facts in *Larson* are not sufficiently similar to those in the present case for the examiner to rely on the rationale used by the C.C.P.A. MPEP 2144.04. The claims at issue in *Larson* were directed to a "mobile fluid carrier unit and a vehicle assembly thereof." *In re Larson*, 144, U.S.P.Q. 347. The C.C.P.A. found that "[l]imitations (1), (2), (3) and (4) [were] clearly met by Tuttle et al. [a cited reference]. As to limitation (5) instead of a brake drum integral with the clamping means, Tuttle et al. show[ed] a brake disc rigidly secured to the clamping means." *Id.* at 349. The C.C.P.A. found that, "[w]hile the brake disc and clamp of Tuttle et al comprise[d] several parts, they [were] rigidly secured together as a single unit. The constituent parts [were] so combined as to constitute a unitary whole." *Id.* The C.C.P.A. commented that the dictionary defined "integral" as "(2) [c]omposed of constituent parts making a whole; composite; integrated." *Id.* On the basis of these facts, the C.C.P.A. was "inclined to agree with the board's construction of the term 'integral' as used in claim 12" and "with the position of the solicitor that the use of a one piece construction instead of the structure disclosed in Tuttle et al. would be merely a matter of obvious engineering choice." *Id.* (citation omitted).

The issue here is not whether a part having "integral" construction is obvious over the description of several secured pieces. *Larson* is not analogous to the present case.

The examiner also relies on *In re Burhans* for the general proposition that "the selection of any order of process steps is *prima facie* obvious in the absence of new or unexpected results," *In re Burhans*, 69 U.S.P.Q. 330 (C.C.P.A. 1946). The examiner's reliance on *Burhans* is misplaced.

¹ Claim 1 merely specifies "introducing at least a portion of the olefinic hydrocarbon stream" from dehydrogenation "into the isomerization unit" to produce a "second hydrocarbon stream," at least a portion of which is introduced with "aromatic hydrocarbons into an alkylation unit." Claim 1.

The claims at issue in *Burhans* involved a relatively simple method for making non-rancid whole wheat flour containing wheat germ, and to the whole wheat flour produced. Claim 4 is a good example of the method claims on appeal in *Burhans*:

4. The method of making genuine whole wheat flour which consists in separating the germs from the wheat, manufacturing flour from the remaining constituents of the wheat, aging the flour, incorporating therein finely divided non-rancid wheat germ constituents, and thereafter impregnating the flour with carbon dioxide.

Id. at 330.² The C.C.P.A. acknowledged that "Dietz, Wellinghoff and Donk et al. [did] not specifically describe the step of aging the flour," but found that aging was "referred to in Byrne and each of the foregoing references contemplate[d] that the flour would be aged prior to its use by the baker." *Id.* at 331. The court noted that "[t]he aging of flour is not only old in the art but it is also conventional as hereinbefore noted." *Id.* at 331. According to the C.C.P.A.,

[i]n Dietz, Wellinghoff and Donk et al. the wheat germ is separately ground and treated to remove the rancid element in the germ and the non-rancid germ is thereafter incorporated in aged flour for the bakers' mixture. Donk et al. also shows that rancidity may be eliminated by storing the germ contents in carbon dioxide, and Byrne discloses that it is old to impregnate flour with carbon dioxide for the purpose not only of rendering freshly ground flour fit for immediate use by the baker but also of preserving the flour by the prevention of its decomposition.

Id. at 331-332. *Burhans* argued that "the references taken singly or together [did] not teach his characteristic four steps which [were] new in the art and which [were] necessary to obtain the desired result." *Id.* However, the C.C.P.A. held that "[t]he cited references considered collectively clearly suggest doing the thing that appellant has done in this case." *Id.* at 332.

In the present case, the examiner has not pointed to a teaching or suggestion in M1 or in M2 of an aromatic alkylation process wherein an "alkylation reaction stream" is separated to produce a "paraffins and unreacted olefins stream," the method comprising:

² Claim 6 read:

The method of making genuine whole wheat bread which consists in separating germ constituents from wheat, reducing the remaining constituents of the wheat to flour, aging the flour, incorporating in the aged flour finely divided non-rancid wheat germ constituents, thereafter impregnating the flour with carbon dioxide, making the flour into dough and baking the dough while the flour still retains a substantial amount of carbon dioxide.

Id.

introducing at least a portion of the paraffins and unreacted olefins stream into a dehydrogenation unit, wherein the dehydrogenation unit is configured to dehydrogenate at least a portion of paraffins in the paraffins and unreacted olefins stream to produce olefins, and wherein at least a portion of the produced olefins exit the dehydrogenation unit to form an olefinic hydrocarbon stream; and

introducing at least a portion of the olefinic hydrocarbon stream into the isomerization unit.

Claim 1. The examiner simply has not pointed to a method in which paraffins are dehydrogenated *after alkylation and before isomerization*, as claimed. In the present case, the examiner has not established that M1 and M2 "collectively clearly suggest doing the thing that appellant has done." *In re Burhans*, 69 U.S.P.Q. at 332.

The evidence in the present case also establishes that there are substantial differences in the isomerization product when paraffins are dehydrogenated *after alkylation and before isomerization*, as claimed. Applicant has been unable to identify similar evidence in *Burhans*. *Burhans* product apparently was the whole wheat product of claim 10:

10. An article of manufacture, genuine whole wheat flour comprising finely divided non-rancid wheat germ constituents and the remaining constituents of the wheat in finely divided and aged condition, the whole mass of the flour being impregnated with carbon dioxide.

Id. at 330. *Burhans* apparently did not present evidence that the whole wheat produced by the processes described, taught, or suggested by the cited references would not meet the foregoing product limitations. Hence, the C.C.P.A. affirmed the finding of obviousness "in the absence of any proof in the record that the order of performing the steps produces any new and unexpected results." *Id.* at 332.

The facts of *Burhans* are not sufficiently similar to those the present case for the examiner to rely on the rationale used in *Burhans*. In the present case, the examiner has not established that the cited references "clearly suggest" the claimed method.

The examiner has not pointed to a teaching or suggestion in any cited reference of an aromatic alkylation process in which dehydrogenation is performed *after alkylation and before isomerization*. The examiner has not provided a "finding as to the specific understanding or principle within the knowledge of a skilled artisan that would have motivated one with no knowledge of [Appellant's] invention to make the combination [of M1 and M2] in the manner

claimed." *In re Kotzab*, 55 U.S.P.Q.2d at 1317-1318. And, as discussed above, the record establishes that there are differences between the isomerization product produced using the claimed method vs. the method described in M1.

The rejection fails to consider the invention "as a whole." Under 35 U.S.C. § 103:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented in the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains.

Emphasis added. "Failure to consider the claimed invention as a whole is an error of law."

Jones v. Hardy, 220 U.S.P.Q. 1021, 1025 (Fed. Cir. 1984).

For all of the foregoing reasons, the examiner has not established that the pending claims are *prima facie* obvious over M1 and M2. Appellant respectfully requests that the Board reverse the rejection of claims 1-43 as obvious under 35 U.S.C. § 103.

III. WHETHER CLAIMS 26-37 ARE OBVIOUS UNDER 35 U.S.C. § 103(a) OVER M1 IN VIEW OF M2 AND FURTHER IN VIEW OF U.S. PATENT NO. 5,523,503 TO FUNK, ET AL. ("FUNK")

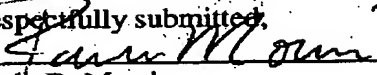
The examiner issued a separate rejection of claims 26-37 as obvious over M1 and M2 further in view of U.S. Patent No. 5,523,503 to Funk, et al ("Funk").

Claims 26-37 depend, directly or indirectly, from claim 1 and are allowable for the foregoing reasons.

CONCLUSION

For all of the foregoing reasons, Appellant respectfully requests that the rejections be reversed. The Commissioner is hereby authorized to charge any fees in connection with this paper, or to credit any overpayment, to Deposit Account No. 19-1800 (File no. TH2229), maintained by Shell Oil Company

Respectfully submitted,


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BOARD OF PATENT APPEALS AND INTERFERENCES
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	§	Group Art Unit: 1764
Paul Marie Ayoub	§	
Serial No.: 10/772,023	§	
Filed: February 4, 2004	§	Examiner: John Christopher Douglas
For: Methods of Preparing	§	
Branched Alkyl Aromatic	§	
Hydrocarbons	§	Atty. Docket: SHELL-TH2229

CLAIMS APPENDIX

1. A method for the production of alkyl aromatic hydrocarbons, comprising:

introducing a first hydrocarbon stream comprising olefins and paraffins into an isomerization unit, wherein the isomerization unit is configured to isomerize at least a portion of linear olefins in the first hydrocarbon stream to branched olefins, and wherein at least a portion of the unreacted components of the first hydrocarbon stream and at least a portion of the produced branched olefins form a second hydrocarbon stream;

introducing at least a portion of the second hydrocarbon stream and aromatic hydrocarbons into an alkylation unit, wherein the alkylation unit is configured to alkylate at least a portion of the aromatic hydrocarbons with at least a portion of the olefins in the second hydrocarbon stream to produce alkyl aromatic hydrocarbons, wherein at least a portion of the produced alkyl aromatic hydrocarbons comprise a branched alkyl group, and wherein at least a portion of the unreacted components of the second hydrocarbon stream, at least a portion of the aromatic hydrocarbons and at least a portion of the produced alkyl aromatic hydrocarbons form an alkylation reaction stream;

separating alkyl aromatic hydrocarbons from the alkylation reaction stream to produce an unreacted hydrocarbons stream and an alkyl aromatic hydrocarbons stream; the unreacted hydrocarbons stream comprising at least a portion of the unreacted components of the second hydrocarbon stream and aromatic hydrocarbons;

separating at least a portion of the paraffins and at least a portion of the olefins from the unreacted hydrocarbons stream to produce an aromatic hydrocarbons stream and a paraffins and unreacted olefins stream; and

introducing at least a portion of the paraffins and unreacted olefins stream into a dehydrogenation unit, wherein the dehydrogenation unit is configured to dehydrogenate at least a portion of paraffins in the paraffins and unreacted olefins stream to produce olefins, and wherein at least a portion of the produced olefins exit the dehydrogenation unit to form an olefinic hydrocarbon stream; and

introducing at least a portion of the olefinic hydrocarbon stream into the isomerization unit.

2. The method of claim 0, wherein the first hydrocarbon stream is produced from an olefin oligomerization process.
3. The method of claim 0, wherein the first hydrocarbon stream is produced from a Fischer-Tropsch process.
4. The method of claim 0, wherein the first hydrocarbon stream comprises olefins and paraffins having a carbon number from 10 to 13.
5. The method of claim 0, wherein the first hydrocarbon stream comprises olefins and paraffins having a carbon number from 10 to 16.

6. The method of claim 0, wherein the isomerization unit is operated at a reaction temperature between about 200 °C and about 500 °C.
7. The method of claim 0, wherein the isomerization unit is operated at a reaction pressure between about 0.1 atmosphere and about 10 atmospheres.
8. The method of claim 0, wherein at least a portion of the branched olefins comprise an average number of branches per total olefin molecules of at least 0.7.
9. The method of claim 0, wherein at least a portion of the branched olefins comprise methyl and ethyl branches.
10. The method of claim 0, wherein at least a portion of the branched olefins comprise an average number of branches per total olefin molecules of less than about 2.5.
11. The method of claim 0, wherein at least a portion of the branched olefins comprise an average number of branches per total olefin molecules of between about 0.7 and about 2.0.
12. The method of claim 0, wherein at least a portion of the branched olefins comprise an average number of branches per total olefin molecules of between about 0.7 and about 1.5.
13. The method of claim 0, wherein at least a portion of the branched olefins comprise an average number of branches per total olefin molecules of between about 1.0 and about 1.5.
14. The method of claim 0, wherein greater than about 50 percent of the branched groups on the branched olefins are methyl groups.
15. The method of claim 0, wherein less than about 10 percent of the branched groups on the branched olefins are ethyl groups.

16. The method of claim 0, wherein less than about 5 percent of the branched groups on the branched olefins are groups other than methyl or ethyl groups.

17. The method of claim 0, wherein the branched olefins have less than about 0.5 percent aliphatic quaternary carbon atoms.

18. The method of claim 0, wherein the branched olefins have less than about 0.3 percent aliphatic quaternary carbon atoms.

19. The method of claim 0, wherein the alkylation unit is configured to produce greater than about 50 percent of monoalkylated aromatic hydrocarbons.

20. The method of claim 0, wherein the alkylation unit is configured to produce greater than about 85 percent of monoalkylated aromatic hydrocarbons.

21. The method of claim 0, wherein a molar ratio of the aromatic hydrocarbons to the branched olefins is between about 0.1 and about 2.0 in the alkylation unit.

22. The method of claim 0, wherein the alkylation unit is operated at a reaction temperature between about 30 °C and about 300 °C.

23. The method of claim 0, wherein the aromatic hydrocarbons comprise benzene.

24. The method of claim 0, wherein the alkyl aromatic hydrocarbons comprise alkyl benzenes.

25. The method of claim 0, wherein the branched alkyl groups of the alkyl aromatic hydrocarbons comprise 0.5 percent or less aliphatic quaternary carbon atoms, and an average number of branches per alkyl group of at least 0.7, the branches comprising methyl and ethyl branches.

26. The method of claim 0, further comprising adjusting a ratio of olefins to paraffins introduced into the isomerization unit by adding at least a portion of a paraffinic hydrocarbon stream into the isomerization unit.
27. The method of claim 0, further comprising:
adjusting a ratio of olefins to paraffins introduced into the isomerization unit by combining a paraffinic hydrocarbon stream with at least a portion of the first hydrocarbon stream upstream of the isomerization unit to form a combined stream; and
introducing the combined stream into the isomerization unit.
28. The method of claim 0, further comprising adjusting a ratio of olefins to paraffins introduced into the alkylation unit by adding at least a portion of a third hydrocarbon stream into the alkylation unit.
29. The method of claim 0, further comprising adjusting a ratio of olefins to paraffins introduced into the alkylation unit by adding at least a portion of a third hydrocarbon stream into the alkylation unit, wherein the third hydrocarbon stream comprises greater than about 90 percent paraffins by weight.
30. The method of claim 0, further comprising:
adjusting a ration of olefins to paraffins introduced into the alkylation unit by combing at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream;
and
introducing the combined stream into the alkylation unit.
31. The method of claim 0, further comprising:
adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second

hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein the third hydrocarbon stream comprises greater than about 90 percent paraffins by weight;

and

introducing the combined stream into the alkylation unit.

32. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein the third hydrocarbon stream comprises greater than about 80 percent paraffins by weight; and

introducing the combined stream into the alkylation unit.

33. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein the third hydrocarbon stream comprises between about 80 percent to about 95 percent paraffins by weight; and

introducing the combined stream into the alkylation unit.

34. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second

hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein the third hydrocarbon stream comprises linear olefins; and

introducing the combined stream into the alkylation unit.

35. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein at least a portion of the second hydrocarbon stream comprises branched olefins; and

introducing the combined stream into the alkylation unit.

36. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream, wherein at least a portion of the third hydrocarbon stream comprises linear olefins and at least a portion of the second hydrocarbon stream comprises branched olefins; and

introducing the combined stream into the alkylation unit.

37. The method of claim 0, further comprising:

adjusting a ratio of olefins to paraffins introduced into the isomerization unit by combining at least a portion of a paraffinic hydrocarbon stream with at least a portion of

the first hydrocarbon stream upstream of the isomerization unit to form a combined stream;

introducing the combined stream into the isomerization unit;

adjusting a ratio of olefins to paraffins introduced into the alkylation unit by combining at least a portion of a third hydrocarbon stream with at least a portion of the second hydrocarbon stream upstream of the alkylation unit to form a combined stream; and

introducing the combined stream into the alkylation unit.

38. The method of claim 0, wherein the dehydrogenation unit is operated at a temperature between about 300 °C and about 700 °C.

39. The method of claim 0, wherein the dehydrogenation unit is operated at a pressure between about 1.0 atmosphere and about 15 atmospheres.

40. The method of claim 0, wherein a residence time of at least a portion of the unreacted hydrocarbons stream in the dehydrogenation unit is such that the conversion level of the paraffins in the unreacted hydrocarbons stream composition to olefins is less than about 50 mole percent.

41. The method of claim 0, wherein introducing the olefinic hydrocarbon stream into the isomerization unit comprises combining at least a portion of the olefinic hydrocarbon stream with at least a portion of the first hydrocarbon stream to produce a combined stream upstream from the isomerization unit, and introducing at least a portion of the combined stream into the isomerization unit.

42. The method of claim 0, further comprising separating non-converted paraffins from the olefinic stream and introducing at least a portion of the non-converted paraffins separated from the olefinic stream into the dehydrogenation unit.

43. The method of claim 0, further comprising introducing at least a portion of the alkyl aromatic hydrocarbon stream into a sulfonation unit, wherein the sulfonation unit is configured to sulfonate at least a portion of the alkyl aromatic hydrocarbons in the alkyl aromatic hydrocarbon stream to produce alkyl aromatic sulfonates, wherein at least a portion of the alkyl aromatic sulfonates produced comprise branched alkyl aromatic sulfonates.

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